CAAM 495 · SENIOR DESIGN PROJECT

Fall 2012 · Rice University

Manifesto

Much of our core undergraduate curriculum in Computational and Applied Mathematics is devoted to fundamental techniques in analysis, numerical analysis, differential equations, and optimization. In most of these courses, applications are brought out to motivate particular mathematical ideas and techniques. Yet the best work in *applied mathematics* does not manifest itself as beautiful mathematics on a quest for some relevant application: rather, some problem (rooted in engineering, physics, biology, economics, social science, ...) wants for a solution, and the professional applied mathematician selects – or invents – those analytical and computational tools best suited to the challenge at hand.

This course puts an applied problem front-and-center, and spends the entire year pursuing a solution. Students draw on the breadth of their education to find the proper tools – learning new techniques as the challenge demands. Such problems are not clean and are not simple; there is no answer in the back of some book. Yet students are not alone in this process: they must work in teams; interdisciplinary collaboration is encouraged. Local mathematical experts can provide invaluable insight to move a problem forward, just as advisors from the motivating application ensure that the team is answering a relevant question.

This is a *design* course: We shall organize our work around the engineering design process, a procedure for identifying project needs, brainstorming solutions, rationally selecting best strategies among those solutions, and developing viable prototypes (often implemented in computer codes). This should be a rich experience that draws together many aspects of your undergraduate education: but much depends on the effort you devote to the cause!

Syllabus

Objectives:	CAAM 495 students learn the engineering design process by developing a mathematical model for an open-ended problem deriving from an application, then rationally selecting a method for implementing the model.
Outcomes:	Upon completing this course, students should be able to: (1) Express an application problem in mathematical form; (2) Assess the challenge of implementing that model; (3) Conduct a comprehensive literature review; (4) Brainstorm solution approaches and rationally select among them; (5) Develop teamwork and project management skills.
Meetings:	Monday, 4-4:59 pm, Duncan Hall 1046 Teams must also schedule a weekly 30 minute meeting with one of the instructors.
Web Site:	http://www.caam.rice.edu/∼design
Instructors:	Thomas Callaghan (Thomas.Callaghan@rice.edu), Duncan Hall 2037, (713) 348-5724 Office Hours: TBA, or by appointment Mark Embree (embree@rice.edu), Abercrombie A101, (713) 348-6160 Office Hours: Friday 11am–12pm, or by appointment
Credits:	2–3 credits Students should generally enroll for 2 credits; under special circumstances (e.g., for interdisciplinary projects), students may enroll for 3 credits, with instructor permission.
CAAM 496:	This course continues in the Spring semester as CAAM 496. Since projects span both semesters, all CAAM 495 students are expected to enroll in the Spring course.
Grade Policy:	Students will be evaluated on their active participation in their projects, as manifest through graded written and oral assignments throughout the semester, and a peer assessment. Grades will be based on both the technical content of the project and the communication of that content. Details follow on the next page.
Honor Code:	Most assignments in this course will be completed in teams, and collaboration is essential. One paper will be an individual project, the content of which students may discuss with each other and the instructors.
Absence Policy:	Students are expected to attend lectures and team meetings, and to actively participate in their groups. Team contributions will be assessed using the CATME assessment tool.
Text Book:	There is no text book for this course. Students can find details about the engineering design process in *Engineering Design: A Project-Based Introduction* by Clive L. Dym and Patrick Little, 3rd ed., Wiley, 2008.

Any student with a disability requiring accommodation in this course is encouraged to contact to contact the instructors, and also to contact Disability Support Services in the Ley Student Center.

Tentative Schedule

20 Aug	What is Applied Mathematics? What is Design? Intro to Mini-Project
27 Aug	Technical memos; Typesetting with LaTeX
5 Sep (Wed)	Project descriptions Due: 10-minute mini-project presentations Due: Technical memo 0 (Mini-project summary)
10 Sep	Project bookkeeping and version control software Project teams assigned.
17 Sep	Conducting a literature review for mathematics and applications Due: Technical memo 1 (Problem Statement)
24 Sep	Mathematical Modeling Widget Due: Technical memo 2 (Literature Review and Application Expert Identification)
1 Oct	Mathematical Modeling Widget
8 Oct	Brainstorming techniques Due: Technical memo 3 (Design Criteria)
15 Oct	Evaluating competing designs Due: Technical memo 4 (Brainstorming: Modeling and Mathematical Approaches)
22 Oct	Mathematical Modeling Widget
29 Oct	Project management tools, Gantt Charts Due: Technical memo 5 (Design Evaluations and Mathematical Expert Identification)
5 Nov	Mathematical Modeling Widget
12 Nov	Delivering effective mathematical presentations Due: Draft of Gantt chart (not graded)
19 Nov	Mathematical Modeling Widget Due: Individual memo (Lessons Learned from Initial Design Experience)
26 Nov	Due: 20-minute mid-project design review presentation
12 Dec	Due: Mid-project design review report

Grades will be determined according to the following weighting.

60% : Technical memos (six memos, 10% each)
10% : Individual memo
10% : Mid-project design review presentation
10% : Mid-project design review paper
10% : Individual team member assessment (CATME) and participation

All papers and presentations will be graded for both content and style. Teams are permitted to re-submit Technical Memos 1–5 to receive partial credit for addressing problems identified in the original grading.